Space Weather Technical Forecast

Issued on Saturday, 28 January 2023 at 12:12 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of R1/R2 Radio Blackouts. Slight chance of G1/Minor Storm Day 4 (31 Jan). Increasing fluence probable bringing chance of Active (1e8 integrated pfu) by Day 4.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is Low with the largest flare emanating from a plage area containing the remains of AR3202 on the northwest limb. This produced a C3 flare peaking at 28/0835UTC. This leaves seven other sunspot regions on the visible disc. However, all regions are small, weak, magnetically simple and mostly stable. No Earth-directed CMEs were detected from available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1 by DSCOVR, is elevated, under the influence of a coronal hole High Speed Stream (HSS) and levels varied between 500-580 km/s. Density remains slightly above average. The total IMF, Bt, was weak as was the north-south component, Bz, which fluctuated weakly between +5/-6nT. The phi angle was positive (away from the Sun). Geomagnetic Activity was Quiet to Unsettled (Kp 2-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has been at background levels throughout. High energy electron flux (greater than 2 MeV) has been at background to moderate levels, peaking at 371pfu at 27/1720UTC. The associated 24-hour integrated electron fluence has been on a steady trend well below the Active threshold, with 7.45 e6 integrated pfu observed at 28/0001 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity probably remaining Low, with a slight chance of an M-class flare throughout the four day period.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are expected and Earth is under the influence of a positive polarity HSS with elevated levels through Day 1 (28 Jan), then a slow decline is most likely over coming days, perhaps reaching slow-ambient by Day 4 (31 Jan). Further negative polarity HSS influence may start to give an enhancement to solar winds later on Day 4, but is more likely to occur after the end of this four day period. Geomagnetic activity is expected to be Quiet to Unsettled (Kp 0-3), with a declining chance of isolated Active (Kp 4) intervals. There is a slight chance of G1/Minor Storms (Kp 5) later on Day 4 if we do see further HSS influence.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES16 is expected to remain at background levels. Electron flux is likely to increase through the period as the HSS wanes. Fluence is also likely to rise, with a chance of reaching Active (1e8 integrated pfu) by Day 4 (31 Jan).

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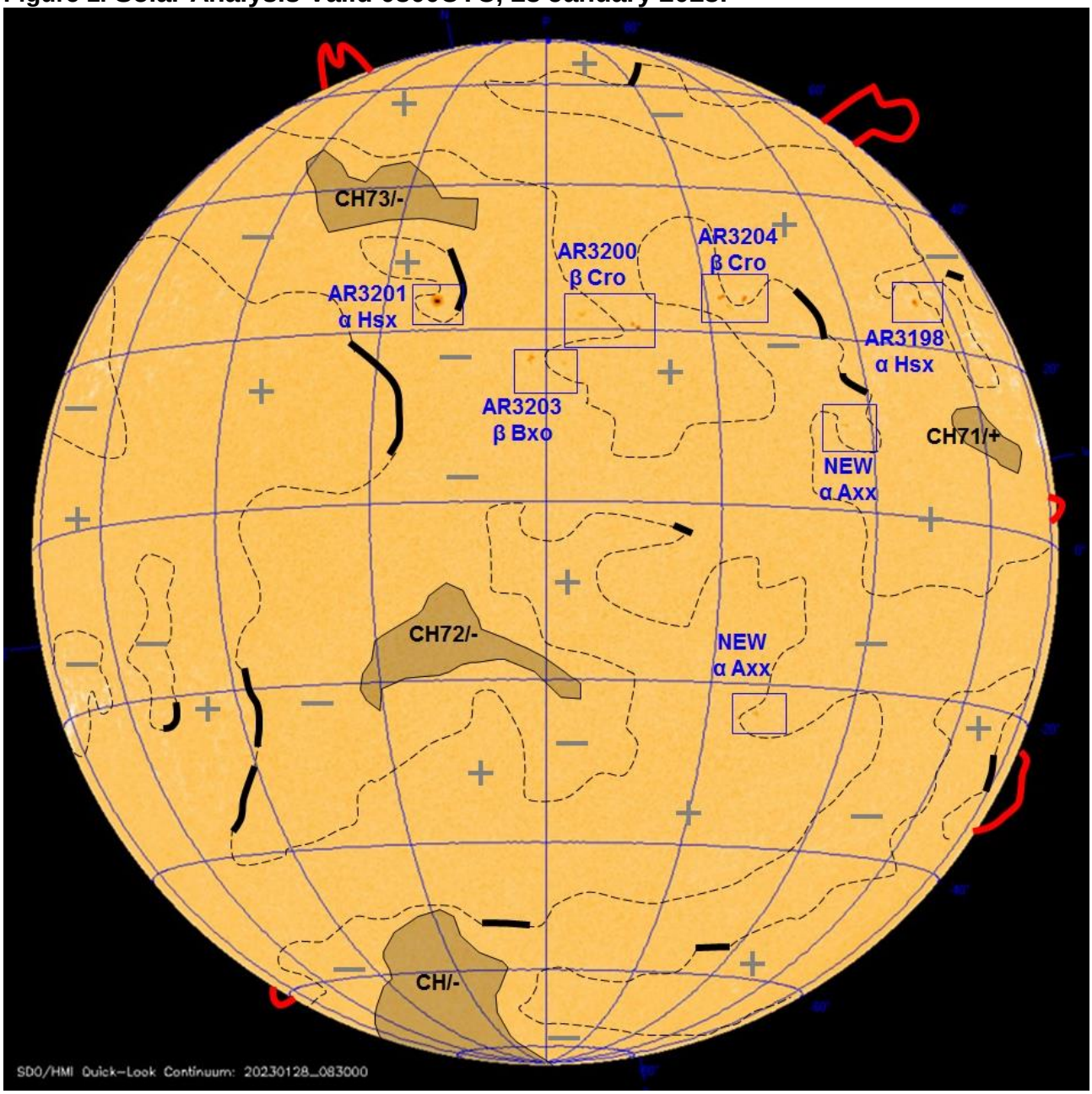
Figure 1. Solar Analysis Valid 0800UTC, 28 January 2023.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs are currently expected during this period. Earth is under the influence of a positive polarity HSS, most likely from CH71 having probably transitioned from CH69 with a slight uptick observed in magnetic field readings. However, both are positive polarity coronal holes so it is a little difficult to judge any transition. Solar winds at elevated levels through Day 1 (28 Jan), then show a slow decline in the coming days, perhaps to slow-ambient levels by Day 4 (31 Jan). CH17 is smaller on this rotation and levels might decline slightly faster on this rotation as CME effects may have prolonged the more elevated levels given by persistence on the previous rotation. A further pair of negative coronal holes, CH72 and CH73, may start to give an increase in wind speeds later on Day 4, but it is more likely to occur after the end of this four day period.

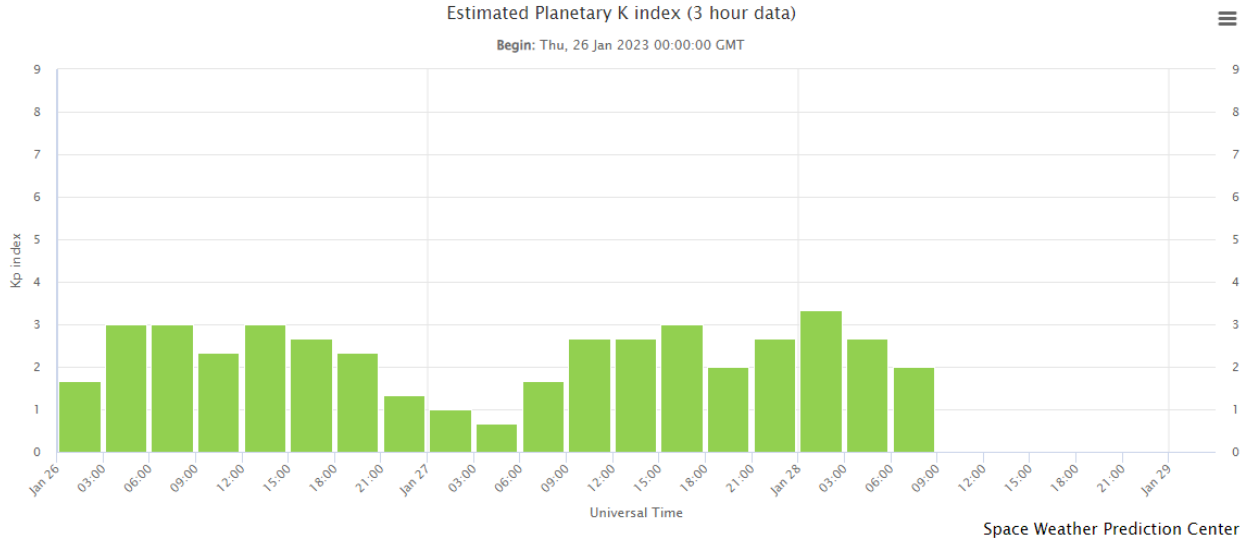
Geomagnetic activity is expected to be Quiet to Unsettled (Kp 0-3) for much of the period, with a declining chance of isolated Active (Kp 4) intervals. At the end of Day 4 (31 Jan) a slight (5%) chance of G1/Minor Storms (Kp 5) has been given in the table above if we do see further HSS influence.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Geomagnetic levels over the past 24 hours as given by NOAA SWPC.


Estimated Planetary K index (3 hour data)
Begin: Thu, 26 Jan 2023 00:00:00 GMT
Kp index
Universal Time
Space Weather Prediction Center

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Radio Blackouts - X-Ray Flares:
There are now eight sunspot regions on the visible disc, all of which are small and simple. There has been some minor growth near centre disc, but these regions appear unlikely to give significant flares at the present time. A new region might rotate onto the southeast limb, and the largest flare observed during 27 January (C5.3) came from this area, but it doesn't currently look to be a significant region. As such, solar activity is expected to be Low with a slight chance of an isolated M-class flare.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	15	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3:X-ray flux levels as observed at GEO by GOES.

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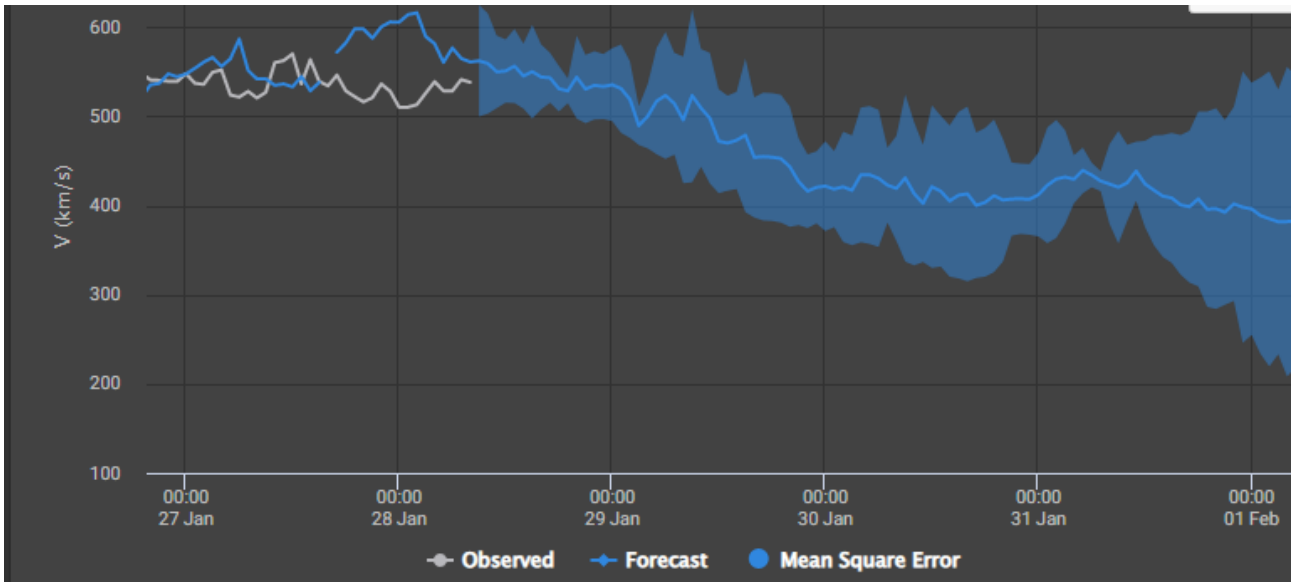
Solar Radiation Storms - (High Energy Protons):
High energy (greater than 10MeV) protons as observed by GOES-16 are currently expected to persist at background levels. The remaining regions on the visible disc are all small and simple, and therefore unlikely to give any significant increase in proton counts.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	2	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Met Office Solar Winds Prediction Model (SWPM) indicating a decline in levels.



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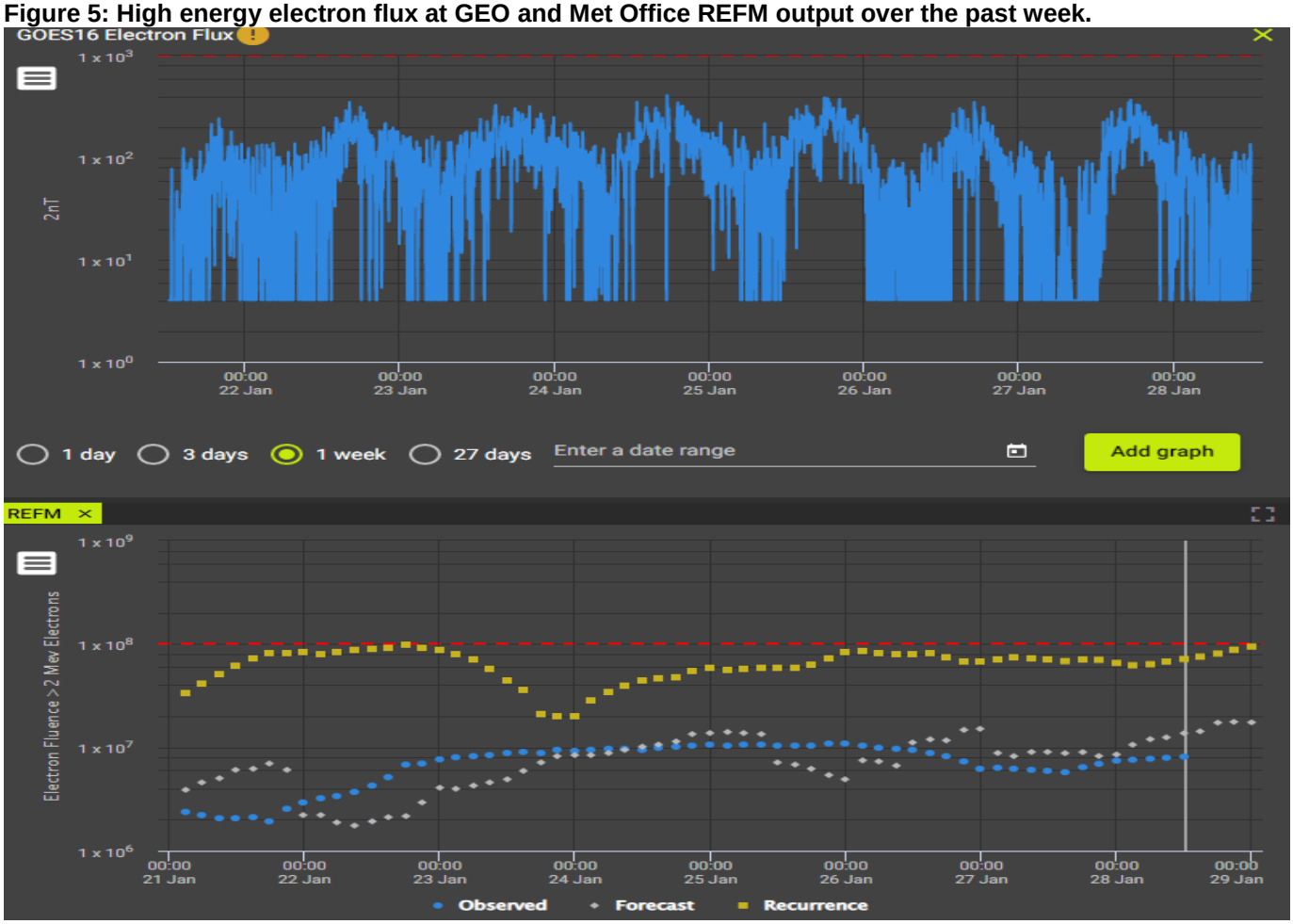
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) is currently varying diurnally between background and moderate levels. This is likely to increase as the HSS influence wanes and the radiation belts de-compress, although the level of any increase depends on how much charging has taken place during the current fast wind.

The associated 24 hour fluence is likely to show an increasing trend through the period with moderate confidence. There is a chance of reaching the Active (1e8 integrated pfu) threshold, although this is low confidence. REFM is currently forecasting an increase below Active up to Day 3 (30 Jan) which seems reasonable. Fluence did reach above Active on the previous rotation, but electron flux was higher at the equivalent of this point in time previously so levels are expected to be correspondingly lower this time around.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	10	20	30
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: High energy electron flux at GEO and Met Office REFM output over the past week.



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